# Wind Driven Coastal Distributions of Optical Materials

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## LONG-TERM GOALS

Our primary goal is improve our understanding of the role of currents associated with coastal upwelling fronts in determining the distributions of bio-optical properties.

## SCIENTIFIC OBJECTIVES

The objectives are to determine:

- How far into the coastal jet are high phytoplankton levels found? Does the jet transport phytoplankton or act as a barrier to phytoplankton transport?
- How is the distribution of optical materials affected by secondary circulation inside of the upwelling front?
- How do the surface currents redistribute optical materials during relaxation events?

## APPROACH

The proposed program will be completed in collaboration with the work being proposed by Tim Cowles, Hemantha Wijesekera and Tim Boyd. The proposals by Wijesekera and Boyd, and Dale and Barth, examine the dynamics of the upwelling front and coastal jet. They will be examining the physical properties, including currents, in this region. We intend to rely on their expertise in collecting and interpreting the velocity measurements that we intend to use in our study. Cowles is interested in the formation and structure of thin layers. Once possible formation mechanism is shear flow at the coastal jet and another is the subduction of phytoplankton from the surface. These mechanisms are related to the surface circulation patterns that we are proposing to study.

We are collecting data with an AUV and with in-line optical sensors. The AUV is Bluefin Odyssey III equipped with an ac-9, downwelling irradiance, and backscattering sensors. We are currently adding an ISUS nitrate sensor to the platform. The AUV will be used to collect near-surface measurements of physical and optical properties that are uncontaminated by the presence of the ship. The in-line measurements will be collected concurrently with the AUV providing surface optical measurements at the same time as the water velocities are measured on the AUV. Iain MacCallum has been hired at a Post Doctoral student to analyze the optical data collected using the AUV.

To determine where to sample we are working in conjunction with Andy Dale who is surveying the region using a Mini-Bat. His surveys provide the large spatial resolution data with which we can identify potential areas of interest. We then return with the AUV and profiling equipment of Cowles to provide high spatial resolution measurements of optical and physical properties.

## WORK COMPLETED

The AUV arrived at Oregon State University in November 2002 and was accepted in December of that year. Since its arrival we have integrated the instrumentation into the payload section and conducted a series of engineering tests. The late winter arrival of the AUV has meant that we have had to learn how to operate it as we are conducting our research. We were able to get funding for additional testing days through the National Undersea Research Program. Upon developing a basic knowledge of the vehicle operations we have conducted two coordinated observation periods with our collaborators.

## RESULTS

Much of our efforts this past year have been in integrating the instruments into the AUV and improving the reliability of the data logging. Instruments incorporated include an ac-9+ (absorption and attenuation plus data logger), eco-vsf (backscattering), OCP (downwelling irradiance and CTD), ADCP (currents above the vehicle), and camera (Fig 1). The data from these sensors are combined with data from the AUV navigation and CTD, and the microsoar microstructure sensor. One of the most difficult tasks has been integrating the payload with the AUV power system and incorporating a timing signal from the AUV in order to merge the data sets being logged to different locations

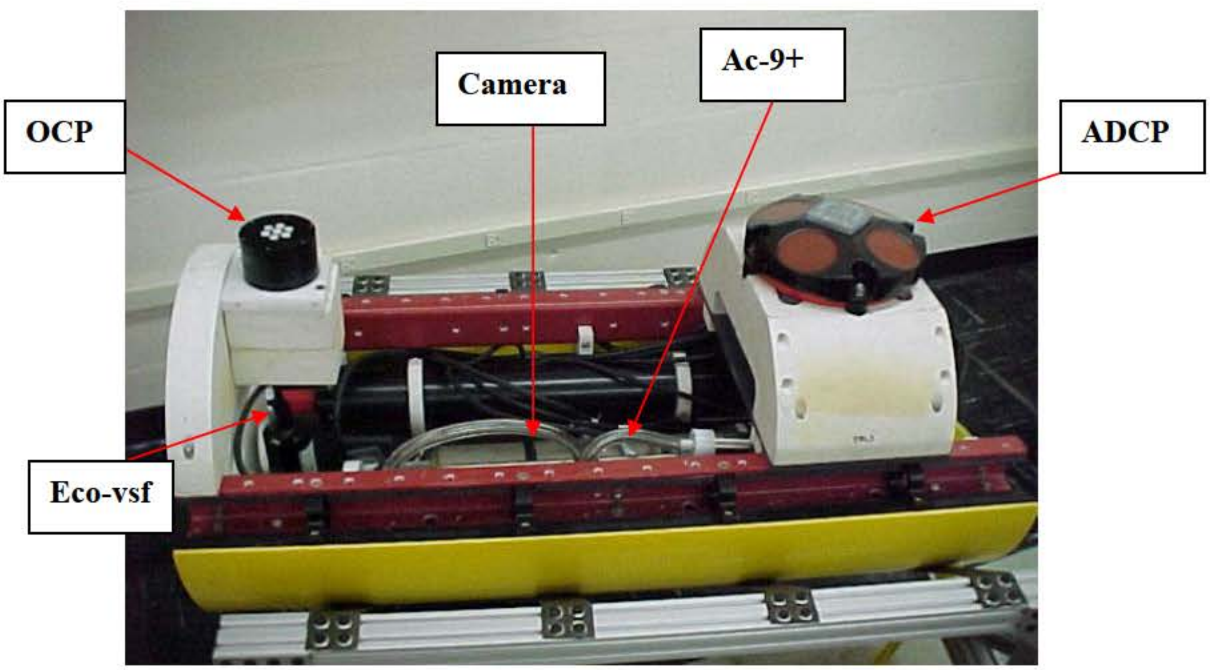


***Figure 1. AUV Payload [Included in the AUV payload are an OCP irradiance sensor, ac-9+ absorption and attenuation meter, eco-vsf backscattering sensor, ADCP current meter, and camera.***

Data collected in the upwelling front show that the secondary circulation causes subduction of surface waters. These waters are marked by their temperature and optical characteristics and are associated with a band of higher diffusivity (Fig. 2).

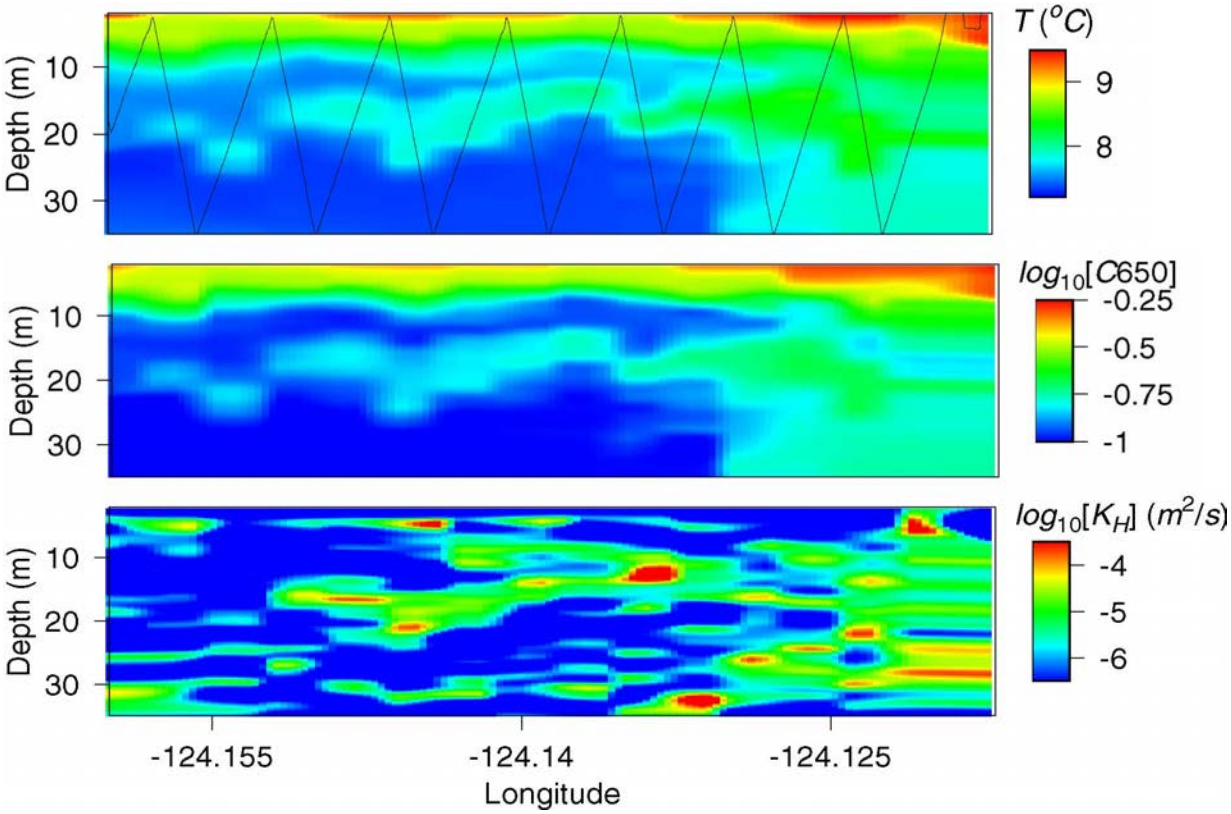


***Figure 2. Temperature, beam attenuation, and diffusivity data collected using the AUV. [The top panel includes temperature measurements with the AUV track in black. An overturn/intrusion in temperature is evident near 20 m depth. The temperature signal is mirrored in the beam attenuation measurement shown in panel 2. The intrusion is a region of higher turbulent diffusivity as seen in panel 3.]***

We are still in the process of merging all data sets to provide a better interpretation of the forcing mechanism that set up the intrusion.

## IMPACT/APPLICATIONS

Secondary circulation associated with the upwelling front is one mechanism for the formation of thin-layers of optical materials that may have ecological significance.

## RELATED PROJECTS

None